

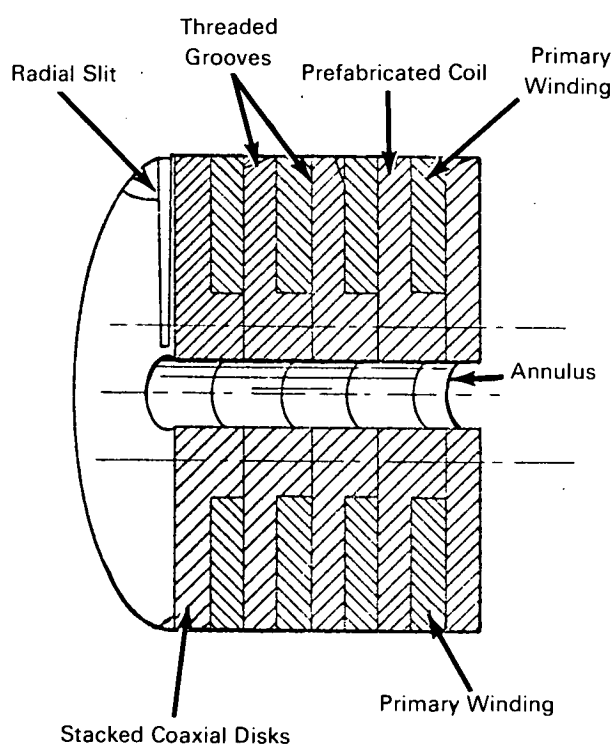


AEC-NASA TECH BRIEF



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Cryogenic Flux-Concentrator



The problem:

To develop a flux-concentrator for producing high magnetic fields. Various apparatus have been used, such as systems employing a hollow, metallic, secondary, cylindrical flux-concentrator, wrapped with primary conductor turns in which a high-frequency voltage is applied. These systems produce the desired concentration of flux, but the coupling between the primary and secondary elements is low because a very large amount of the applied ampere turns to the flux-concentrator is wasted in fringing fields.

The solution:

A flux-concentrator magnet having primary and secondary windings for producing a high magnetic field. A high primary-to-secondary coupling efficiently produces high magnetic fields of from 100 to 150 kOe. The device provides versatility for a wide variety of pulse durations, applications, magnetic-field strengths, and power sources; it is constructed of simple, efficient, interchangeable, prefabricated components.

In tests, the magnet and flux-concentrator have survived 400,000 pulses at peak power input of 1.6 MW, a peak current of 3850 A with a primary winding of 208 turns, pulse duration of 50 msec having a high-field duration above 80% of peak for 40 msec, a repetition rate of one pulse per 3 sec, an average power input of 24 kW, an energy input of 73 kJ per pulse, and a field of at least 100 kOe.

How it's done:

The cryogenic flux-concentrator magnet has a primary winding and an inner secondary winding that interact to produce a higher field in the bore of the secondary winding than is produced in the bore of the primary winding alone. The flux-concentrator has stacked disks forming radial slits, with removable prefabricated coils between each pair of disks.

The figure shows a partial cross section of the flux-concentrator with individual primary, prefabricated coils interposed between a plurality of coaxial disks forming a secondary cylinder. The stacked coaxial disks can be put together in any shape desired. The number of turns and the primary winding can be matched to any power supply.

The disks are provided with stainless-steel clamps for selective stacking and unstacking to resist the tendency of the magnetic field to expand the bore. The

(continued overleaf)

radial slits in disks are sequentially spaced progressively in rotation from one another by 60°.

The concentrator has a laminated iron core outside the flux-concentrator and in an unused portion of the bore to increase the magnetic field in the bore. Liquid nitrogen is the cryogenic coolant for the primary winding.

Notes:

1. Further information is available in Patent Disclosure 3,384,849, U.S. Patent Office, 21 May 1968.
2. This innovation may interest manufacturers of superconducting magnets and researchers in nuclear physics.
3. Inquiries concerning this innovation may be directed to:

Office of Industrial Cooperation
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Reference: B69-10654

Source: H. Brechna, D. A. Hill, and B. M. Bailey of
Massachusetts Institute of Technology
under contract to
Argonne National Laboratory
(ARG-10494)

Patent status:

Inquiries concerning rights for commercial use of this innovation may be made to:

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U.S. Atomic Energy Commission
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